Math 112 : Calculus : Integration and its applications

(draft version : last updated : 2022–03–18)

Disclaimer

The information contained in this syllabus, other than the absence policy, is subject to change with reasonable advance notice.

Course Information

Course Logistics

Class time	:	Tuesday & Thursday, 09h25 – 10h40
Class room	:	George R. Brown Hall (GRB) W211
Office hours	:	Tuesday, 12h00 – 13h30, Herman Brown Hall (HBH) 208
Recitation	:	Sunday, 13h30 – 15h00, Humanities Building (HUM) 118
TA sessions	:	Monday, 18h00 – 20h00, Maxfield 252
		Tuesday, 18h00 – 20h00, Brockman 101
		Wednesday, 19h00 – 20h00, Maxfield 252
		Thursday, 18h00 – 20h00, Brockman 101

Instructor Information

Instructor	:	Stephen Wolff
Office	:	HBH 208
E-mail	:	Stephen.Wolff@rice.edu

Textbook

This course is based on the textbook

OpenStax : *Calculus*, Volume 1 and Volume 2, by Herman, Strang, et al.

The books are available free of charge at the links above (URLs below[1]).

We will wrestle with the following topics ("Vv.c" denotes Volume v, Chapter c):

- V1.2. Limits
- V1.3. Derivatives
- V1.4. Applications of derivatives
- V2.1. Integration
- V2.2. Applications of integration
- V2.3. Techniques of integration

[1] The URLs for Volume 1 and Volume 2, respectively, are

1. https://openstax.org/details/books/calculus-volume-1
2. https://openstax.org/details/books/calculus-volume-2

Absence Policy

Class attendance is strongly encouraged. We will take and accept responsibility for our actions and decisions.

Grading Policy

Our goal in this course will be mastery of the concepts we engage. We will promote and assess mastery using the following tools:

1. **Homework (H).** There will be homework every day. All resources are allowed. Homework is due promptly by 09h30 the next class. Late homework will not be accepted. Homework will be graded 0–2 using a "reasonable attempt" rubric. Your lowest 3 homework scores will be dropped.

2. **Quizzes (Q).** There will be an in-class quiz every day. No external resources are allowed. Quizzes come in two flavors: short quiz (SQ) and long quiz (LQ). SQs are about 3 minutes on key concepts. SQs will be graded 0–2 and count as bonus. LQs are about 10 minutes on a (new) exercise. LQs will be graded 0–4. Some quizzes you will be able to discuss with your colleagues before submitting. Others will be solo. You may "re-quiz" LQs throughout the semester. Only your highest grade on each LQ sequence will count toward your course grade.

3. **Exams (E).** There will be three midterm exams (ME) and one final exam (FE). No external resources are allowed. Each exam will be cumulative. The final exam will have three sections, with content corresponding to that of the three MEs. For each section of the FE, if your score on that section is higher than your score on the corresponding ME, then your FE score (for that section) will replace your ME score. See page 5 for exam dates.

4. **Communication (C).** There will be a team project (TP) and an oral exam (OE). For the team project, you will solve past exam questions, exchange feedback with peers on your solutions, and typeset your revised solutions. The final week of classes, each student will have a 15-minute oral exam (a scary term for "math chat").

Course grade. Your course grade is allocated among the above tools as follows:

H : 10% LQ : 20% each ME : 10% FE : 30% TP : 8% OE : 2% SQ : 2% bonus

Example. Suppose that prior to the final exam, you submit all homework, earn 80% on long quizzes and 100% on short quizzes, score 80% on each midterm exam, and earn 80% in communication (team project and oral exam). If you score 70% on each section of the final exam, then your course grade is

$$\underbrace{100\% \times 10\%}_{\text{H}} + \underbrace{80\% \times 20\%}_{\text{LQ}} + \underbrace{3 \times (80\% \times 10\%)}_{\text{ME}} + \underbrace{70\% \times 30\%}_{\text{FE}} + \underbrace{80\% \times 10\%}_{\text{C}} + \underbrace{100\% \times 2\%}_{\text{SQ}} = 81\%$$

If you score 90% on each section of the final exam, then your course grade is

$$\underbrace{100\% \times 10\%}_{\text{H}} + \underbrace{80\% \times 20\%}_{\text{LQ}} + \underbrace{3 \times (90\% \times 10\%)}_{\text{ME}} + \underbrace{90\% \times 30\%}_{\text{FE}} + \underbrace{80\% \times 10\%}_{\text{C}} + \underbrace{100\% \times 2\%}_{\text{SQ}} = 90\%$$

Course Objectives and Expected Learning Outcomes

Our goal, by the end of this course, is to be able to accurately and confidently

- Assess what we know and what we don't yet know.
- Communicate math clearly and effectively with others.
- Perform fundamental math operations (e.g., simplifying and evaluating algebraic expressions, using functions, graphing in $\mathbf{R}^2$, using logic).
- Use and evaluate limits.
- Use and evaluate derivatives.
- Perform implicit differentiation and apply it to problems involving related rates.
- Use l'Hôpital's rule, and know when not to use it.
- Link algebraic, geometric, and physical views of derivatives and integrals.
- Define and use antiderivatives (aka indefinite integrals).
- Define and use definite integrals.
- State and use the fundamental theorem of calculus.
- Use integration techniques, including substitution and integration by parts.
- Use and evaluate improper integrals.
- Use Taylor series, and understand why they are useful.

Resources

Potentially helpful resources:

- Past exams are hosted on the Calculus Resources page on Canvas. See the page "Math Exam Help" for log-in instructions. (You will need a valid Rice NetID.)
- Solutions to selected exercises from the OpenStax textbooks are hosted on the OpenStax website, under the Student Resources tab for each book. (Here are links to the tabs for Volume 1 and Volume 2.)

Students with Disabilities

Any student with a documented disability that requires accommodation is encouraged to contact both the course instructor (Stephen.Wolff@rice.edu) and the Rice Disability Resource Center (adarice@rice.edu; Allen Center, Room 111).

Rice Honor Code

As a student at Rice University, you pledge to uphold the Rice Honor Code, which you can find in the Honor System Handbook.

On homework, all resources are allowed. In particular, you are strongly encouraged to work with one another. The purpose of homework is to help you to learn, practice, and internalize concepts.

On quizzes and exams, no external resources are allowed, unless the instructor explicitly indicates otherwise. The purpose of quizzes and exams is to help you to see what you can do so far and identify what you want to work on.

Religious Accommodations

Every reasonable effort will be made to allow members of the university community to observe their religious holidays without jeopardizing the fulfillment of their academic obligations. Absence from classes or examinations for religious reasons does not relieve students from responsibility for any part of the course work required during the period of absence. It is the obligation of students to provide faculty with reasonable notice of the dates of religious holidays on which they will be absent.

Title IX Statement

Rice University cares about your wellbeing and safety. Rice encourages any student who has experienced an incident of harassment; pregnancy or gender discrimination; or relationship, sexual, or other forms interpersonal violence to seek support through the SAFE Office. Please be aware, when seeking support on campus, that most employees (including myself, as an instructor) are required by Title IX to disclose all incidents of non-consensual interpersonal behaviors to Title IX professionals on campus, who can act to support students and meet their needs. For more information, please visit safe.rice.edu or e-mail titleixsupport@rice.edu.

Calendar

Below is a preliminary schedule of topics. Section numbers refer to pdf versions of OpenStax : *Calculus*, Volume 1 (V1) or Volume 2 (V2).

Table 1: Math 112 : Spring 2022 : Preliminary schedule. ("Vv:c.s" denotes Volume v, Chapter c, Section s.)

Week	Day	Date	Topics	Sections	Special HW
01	T	11 Jan	Intro. Diagnostic quiz. Review.	V1:1.1–5	
	R	13 Jan	Limits and continuity.	V1:2.2–4	
02	T	18 Jan	Derivatives as rates of change.	V1:3.2–4	
	R	20 Jan	Differentiation. Linearization.	V1:3.3,4.2	
03	T	25 Jan	Implicit differentiation.	V1:3.8	
	R	27 Jan	Implicit differentiation.	V1:3.8	
04	T	01 Feb	Implicit differentiation. Related rates.	V1:4.1	Mock exam 1
	R	03 Feb	Related rates. Optimization.	V1:4.1,7	
05	**T**	**08 Feb**	**Midterm exam 1.**	⩽V1:4.7	
	10–11 Feb		*Spring recess — no class.*		
06	T	15 Feb	Limits. L'Hôpital's rule.	V1:2.3,4.8	
	R	17 Feb	L'Hôpital's rule.	V1:4.8	
07	T	22 Feb	L'Hôpital's rule.	V1:4.8	Exam 1 corrections
	R	24 Feb	Antiderivatives.	V1:4.10	
08	T	01 Mar	Antiderivatives.	V1:4.10	
	R	03 Mar	Approximating area.	V2:1.1	Mock exam 2
09	T	08 Mar	Definite integral. Review.	V2:1.2	
	R	**10 Mar**	**Midterm exam 2.**	⩽V2:1.2	
10	*12–20 Mar*		*Spring break — no class.*		
11	T	22 Mar	Fundamental theorem of calculus.	V2:1.3	Exam 2 corrections
	R	24 Mar	Integration formulas.	V2:1.4	
12	T	29 Mar	Substitution.	V2:1.5	
	R	31 Mar	Area between curves.	V2:2.1	
13	T	05 Apr	Volumes of rotation.	V2:2.2–3	
	R	07 Apr	Integration by parts.	V2:3.1	Mock exam 3
14	T	12 Apr	Improper integrals. Review.	V2:3.7	
	R	**14 Apr**	**Midterm exam 3.**	all	
15	**?**	**TBD**	**Oral exams.**		
	T	19 Apr	Review.		Exam 3 corrections
	R	21 Apr	Review.		
	F	22 Apr	Due : Team project.		
16	**S**	**30 Apr**	**9h00 : DCH 1042 : Final exam.**	all	